

What Is Claimed Is:

1. A method for examining a surface of a sample using an atomic force scanning microscope (AFM) comprising a cantilever with a longitudinal extension along which a measuring tip is disposed, which is selectively arranged relative to said sample surface by a driver means and whose spatial position is detected using a sensor unit, and said microscope is provided with at least one ultrasound generator, which initiates vibration excitation at a given excitation frequency between said sample surface and said cantilever, the measuring tip of which is brought into contact with said sample surface in such a manner that said measuring tip is excited to vibrations which are oriented lateral to said sample surface and perpendicular to said longitudinal extension of said cantilever and that the torsional vibrations induced in said cantilever are detected and analyzed by means of an evaluation unit,

wherein

- said vibration excitation occurs in such a manner that the oscillations executed by said measuring tip have higher harmonic vibration parts relative to the excitation frequency,
- said vibration excitation is conducted at excitation amplitudes which lead inside said cantilever to torsional amplitudes, the maximum values of which form a largely constant plateau value despite increasing excitation amplitudes and the resonance spectra of which undergo, in the range of said maximum values of said torsional amplitudes, a widening of the resonance spectrum which is determinable by a plateau width, and
- used for examining said sample surface are said resonance spectra, preferably the plateau value, the plateau width and/or the gradient of the respective resonance spectra.

2. The method according to claim 1,
wherein by way of sequential scanning at a multiplicity of different points of contact between said measuring tip and said sample surface successive resonance spectra are detected and analyzed.

3. The method according to claim 1 or 2,
wherein in examining said sample surface, tribological properties such as frictional force and/or frictional coefficients at said sample surface are analyzed and qualitatively and/or quantitatively determined.
4. The method according to one of the claims 1 to 3,
wherein said measuring tip makes contact on said sample surface with a vertical load which is constantly adjusted by said driver means.
5. The method according to one of the claims 1 to 4,
wherein said ultrasound generator emits a continuous wave signal vibrating at said given excitation frequency, said continuous wave signal being varied by means of frequency wobulation within a given excitation frequency range Δf_a .
6. The method according to claim 5,
wherein said given excitation frequency range Δf_a is selected in such a manner that the basic resonant vibration f_r of said cantilever in contact with said sample surface via said measuring tip is contained within said frequency range.
7. The method according to claim 6,
wherein for determining the basic resonant vibration f_r of said cantilever lying on said sample surface with said measuring tip, said sample surface is impinged with a frequency sweep.
8. The method according to claim 7,
wherein said frequency sweep comprises the following frequencies f :
 $f < f_r$ and $f < 30 \times f_r$.
9. The method according to one of the claims 5 to 8,
wherein said excitation frequency range Δf_a comprises frequencies from $f_r - \frac{1}{2}f_r$ to $f_r + \frac{1}{2}f_r$, preferably $f_r - \frac{1}{2}\Delta f_r$ to $f_r + \frac{1}{2}\Delta f_r$, with Δf_r corresponding to the half-width value of the resonance curve at f_r .

10. The method according to one of the claims 5 to 9,
wherein said torsional vibrations of said cantilever lying on said sample surface with said measuring tip are detected using said sensor unit at a frequency range $n \times \Delta f_a$, with $n < 25$, preferably $2 < n < 10$.
11. The method according to one of the claims 2 to 8,
wherein the information obtainable from said resonance curve at each point of contact between said measuring tip and said sample surface, such as the half-width value Δf_r of said resonance curve at f_r , the plateau width, the plateau value, the gradient at said plateau or the vibration amplitude of the higher harmonics are recorded and represented encoded as color values.
12. The method according to one of the claims 1 to 11,
wherein said vibration excitation of said sample surface occurs via said ultrasound generator in such a manner that said ultrasound generator is directly or indirectly acoustically connected with said sample surface.
13. The method according to one of the claims 1 to 12,
wherein a microscopic image of said sample surface is obtained by means of sequentially scanning said sample surface, said microscopic image containing information relating to the surface topography as well as the tribological properties.
14. The method according to one of the claims 1 to 13,
wherein said torsional vibrations forming inside said cantilever are detected by said sensor unit and the sensor signals obtained by said sensor unit are examined with the aid of a wideband amplifier and subsequent spectral analysis.
15. The method according to claim 14,
wherein said spectral analysis is conducted using numerical Fourier transformation or FFT, Wavelet-transformation or Walsh-transformation.